AWARENESS:
A PARALLEL APPROACH AGAINST NOISE

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Unlike other pollutants, many of the noise effects on people have a clear subjective component that go beyond the objective physiological effects that the physical phenomenon causes. Among them, annoyance is the most documented subjective response to noise, it being defined as a feeling of discomfort or displeasure that occurs when noise intrudes our everyday activities. For decades it has been one of the hot topics of environmental acoustics. But, while many studies have focused on the possible correlation between sound metrics and the adverse reaction of the population, the effect of non-acoustic factors on the annoyance response has recently emerged as a hot topic in international transport research groups.
The aim of this paper is to present a novel approach to the assessment of noise impacts that could be of value to railway operations, complementing traditional approaches based on the reduction of exposure. Awareness comprises several non-acoustical factors pointed out in the past as affecting annoyance: information (accessibility, transparency and understanding), trust, influence/voice, attitude towards the source, predictability of the noise situation, awareness of negative effects... The project aims to obtain knowledge of this factor, analyse its influence, and take advantage of it to mitigate annoyance. This is an approach that has not been exploited in depth in the past, and does not imply the reduction of noise emissions at all, so that it can be managed together with other noise control measures. It is based on the hypothesis that "bringing information closer to residents will reduce noise annoyance", and tries to answer the following question: How does Awareness Influence Noise Annoyance? To what extent can Communication or other Non-Acoustical measures modify Awareness in order to help residents to cope with Noise?

1. Introduction

1.1 Environmental noise

Industry and transport, tourism or cultural and leisure activities can contribute to shaping the basis of the continuous growth and development of a society. But these activities also have, among others, the disadvantage that they produce noise pollution, which is a source of adverse effects on the health and welfare of citizens, and, therefore, it is a cause of confrontation among the agents involved, from sectors such as industry, transport, local authorities and citizens.

In Europe there was an important milestone in 2002, when the Environmental Noise Directive (END) [1] was approved, addressing the problem produced by noise, and establishing the first steps

in fighting noise pollution. Strategic Noise Mapping, defined in the END, were planned to be instruments for the diagnosis of noise exposure and for information to the public. Furthermore, they had to be crucial tools for setting up and implementing action plans to mitigate noise at a local level, and to define strategic policies at a European level.

The European Commission (EC) started paying greater attention to environmental noise as a pollutant, supporting several research projects and other initiatives addressing the implementation of the END (harmonization of methods for strategic noise mapping, implementation of action plans…), and the reduction of noise levels in Europe, either by applying acoustic engineering at the source or researching on sustainable infrastructures and new materials… In the following lines, we list some of the projects and initiatives funded by the EC that are most relevant to the background and objectives expressed in this paper:

- HARMONICA: It has developed innovative tools to better inform the public about environmental noise, and to help local authorities to address noise pollution management. A new noise index and optimized web platform have been developed to provide information about environmental noise in European cities.
- CITYHUSH: A major objective is to provide municipalities with tools to establish noise maps and action plans. The project focuses on the reduction of road traffic noise in cities, and is aimed at developing new indicators for noise assessment, and providing validated technical solutions for specific situations.
- SILENCE: This project focused on the development of tools for the implementation of action plans that can be applied to surface transport in cities (road and railway traffic).
- HOSANNA: The main idea was to optimise the use of natural and artificial elements for reducing the noise impact of road and rail traffic.
- QCITY: It develops a catalogue of experimentally validated technical solutions for reducing railway and road traffic noise pollution.

1.2 Annoyance and non-acoustic factors

Annoyance is the most documented subjective response to noise, it being defined “as a feeling of resentment, displeasure, discomfort, dissatisfaction or offence which occurs when noise interferes with thoughts, feelings or activities” [2]. Research on annoyance started in the 1970s, and for decades it has been one of the main topics regarding environmental acoustics, especially in residential areas near transport infrastructures. But, while many studies have focused on trying to establish the correlation between sound level metrics and the adverse reaction of the population [3-7], the effect of non-acoustic factors on the annoyance response has recently emerged as a hot topic in international transport research groups [8,9].

Special mention must be made in the case of two specific research projects funded by the European Commission, both addressing aircraft noise. The SEFA project (2004-2007) was the first approach to applying sound engineering practices to aircraft noise annoyance reduction, reducing sound levels but also improving the characteristics of noise signatures. Afterwards, from 2009-2013, the COSMA project took over, to provide “Community Oriented Solutions to Minimise Aircraft Noise Annoyance” [10]. The interdisciplinary approach in COSMA has points in common with recent trends in acoustic research (soundscapes or sound quality), setting people’s subjective perception and reactions to noise as the target.

The state of the art has shown that non-acoustic factors are important, but has not yet reached any definitive conclusions as to which of them are likely to be the most important in any different situations. Furthermore, very recent qualitative research using focus groups and in-depth interviews has found that the information provided by transport managers and industry to the public with the aim of reducing annoyance, e.g. noise contours, can often be perceived as overly technical, poorly understood, counter-intuitive and inconsistent with subjective experience [11].

2. A parallel approach against noise

2.1 Concept

In this paper we present a novel approach, under research, that explores the possibility to take advantage of those non-acoustic factors related to awareness in noise management and the mitigation of noise effects.

Awareness comprises several non-acoustic factors pointed out previously [9], as affecting annoyance: information (accessibility, transparency and understanding), trust, influence/voice, attitude towards the source, predictability of the noise situation, awareness of negative effects, interaction of stakeholders, and engagement. The research project that we are starting aims to obtain knowledge regarding this awareness factor, analyse its influence, and take advantage of it to mitigate annoyance.

This is an approach that has not been exploited in depth in the past, and that is closely linked to the rise in information and communication technologies. It does not imply the reduction of noise emissions either at the source or in the path, and it will not replace traditional noise mitigation methods aimed at reducing or shaping exposure, but it can be managed together with these other noise control measures, complementing them with the subjective response of the community. The goal of this initiative is to reduce noise annoyance by exploring the hypothesis that "bringing information closer to citizens will reduce noise annoyance", and trying to answer the following question: How does awareness influence noise annoyance? To what extent can communication or other non-acoustic measures modify awareness in order to help residents to cope with noise?

2.2 Methodology

The research project that we have recently started focuses specifically on the influence that the awareness factor has on noise annoyance, and tries to identify the relations between the subjective variable annoyance and the strategies used by noise managers to engage and communicate with the public (yellow box in Figure 2).

The project has three main work packages, described in the following work sub-sections.

2.2.1 Hypothesis testing

A before-and-after noise annoyance study will be performed concentrating the effort on having an answer to the following question: Is it possible to modify noise annoyance in an area by installing a noise monitoring system and providing measurement data to citizens? This is a key question in this research, as it is closely connected to the hypothesis that “bringing information closer to citizens will reduce noise annoyance”. If the hypothesis is confirmed, we can explore some other variables to improve the efficacy of the communication and reporting mechanisms.

2.2.2 Bringing information closer to the public

Noise monitoring schemes have been introduced during the last decades in an attempt to improve the acceptation of noisy activities, to inform the public and to examine noise limits infringements. The generalized use of the Internet in recent years has allowed improving data accessibility by the general public, but: a) information reported is overly technical, and should be customized for different users’ profiles, so that they can understand the information provided; b) commonly used noise prediction indexes do not satisfy the general public’s expectations, as, on some occasions, they seem to mask the real pollution under mathematical operations.

“Bringing information closer to the public” means customizing it to target meaningful and friendliness, in order to optimize the awareness-based mitigation strategies. Lab studies will be implemented to test traditional and novel reporting templates aimed at improving awareness, comprehensibility, and properly matching noise scenarios to people’s perception. As a result of this work package, optimized reporting mechanisms will emerge.

2.2.3 *Field experiment*

The field experiment will rely basically on two key issues: a) residents participating in an online diary-survey to evaluate single events and hourly annoyance; b) noise monitoring units being installed in each dwelling, and reporting noise data to residents while they participate in the experiment (so that they will hear noise and have measurement results at the same time).

Throughout the field trials, the information system will progress through different stages, to create different analysis settings:

- Metrics presence or absence: does annoyance change when residents receive information on noise levels?
- Precision and accuracy: A random contribution will be added to the monitoring reports so as to analyse this influence on the overall response.
- Comprehensibility: how do the noise metrics and the interfaces used for communication modify annoyance?
- Reliability: the system will report random results, so that the participant cannot trust them.
- Plausibility: the system will report biased, but plausible results, so that trust is not questioned.
- Location: can annoyance be modified if the monitor is installed in each resident's home?

3. Impact

This approach is particularly necessary in today's technologized world, where the irruption of information and communication technologies (ICTs) and social media give voice to citizens, creating wider audiences, and opening the possibility to create debates on any topic on any geographical scale. Figure 1 summarizes the new Policy making 3.0 (PM30) model [12] that is highly dependent on the development of ICTs and social media, and tries to gain the participation and involvement of citizens and stakeholders in the solution of citizen's demands.

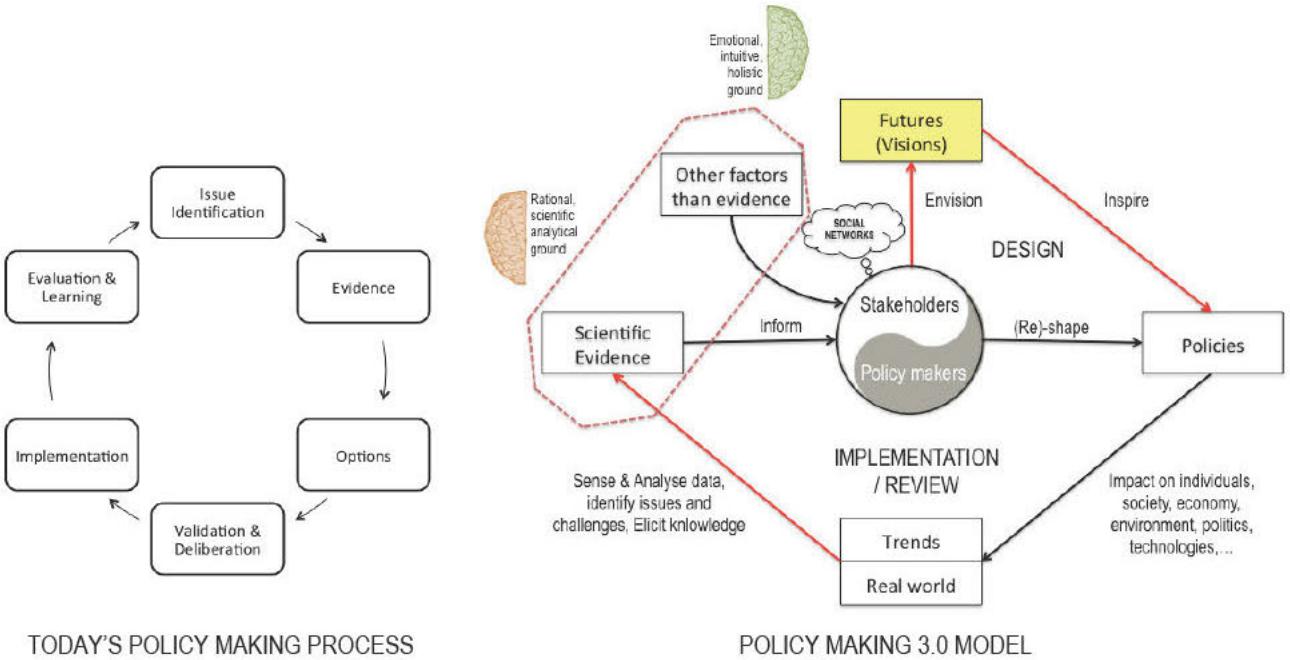

Figure 1. Today's policy making vs. Policy making 3.0

In the long-term, the proposed awareness approach must produce scientific evidence if the capabilities that the new technologies provide are to be properly exploited. This evidence will shape future noise management strategies, so that they can adapt a) to the new policy-making models; b)

to the use of collective awareness platforms for sustainability and social innovation [13]; and/or c) to the growth of sustainable transport and smart cities.

Figure 2 proposes the customization of the PM30 model to fit the management requirements of any noise source (railway, aircraft, road traffic, industry, leisure…) or even in the case of urban noise in smart cities.

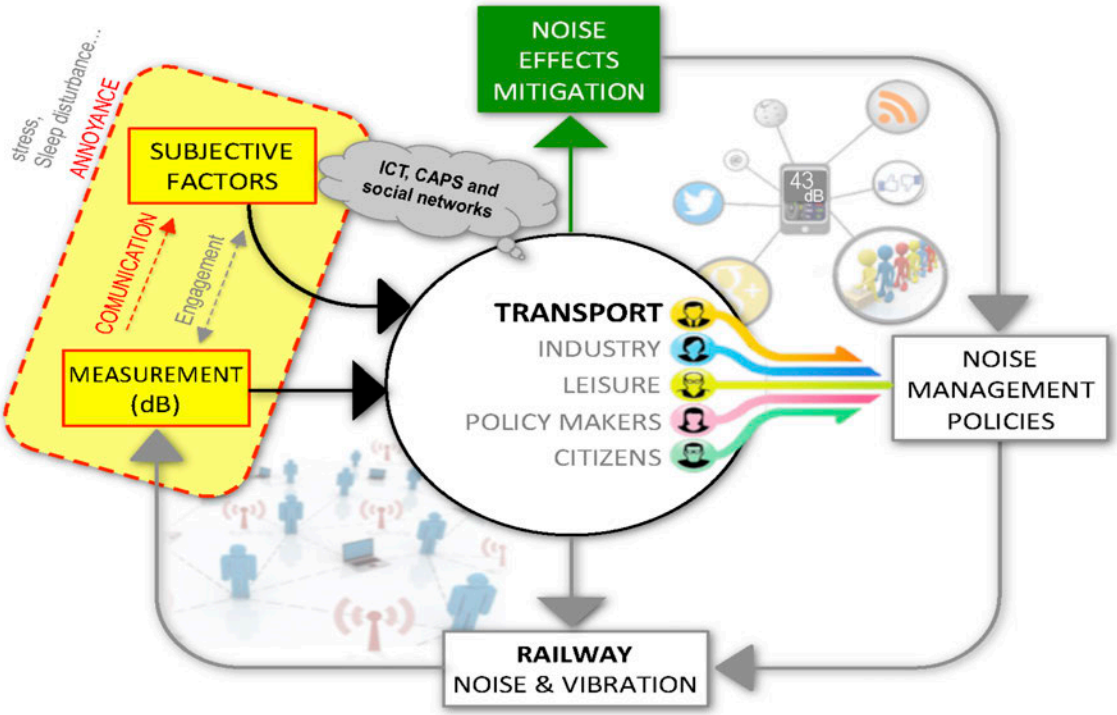

Figure 2. Policy making 3.0 application in noise management

Even if the hypotheses in the project are not confirmed, there will be some valuable outcomes that can be applied to traditional approaches:

- Assessment of noise reporting mechanisms by the general public
- Optimized templates for noise reporting
- Information about social requirements concerning the precision and accuracy of instruments
- Information about social requirements concerning monitoring locations and proximity

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